

STS-104 (BI108)

FLIGHT READINESS REVIEW

PROGRAM

June 28, 2001

Solid Rocket Booster

AGENDA

Presenter:

Roger Elliott

Organization/Date:

USA-SRB/6-28-01

- Changes Since STS-100/BI107 – None to present
- Nonconformances - None to present
- Technical Issues
 - BSM Residual Propellant
- Readiness Assessment
- Certification Sheet

TECHNICAL ISSUE

BSM RESIDUAL PROPELLANT

Presenter:

Roger Elliott

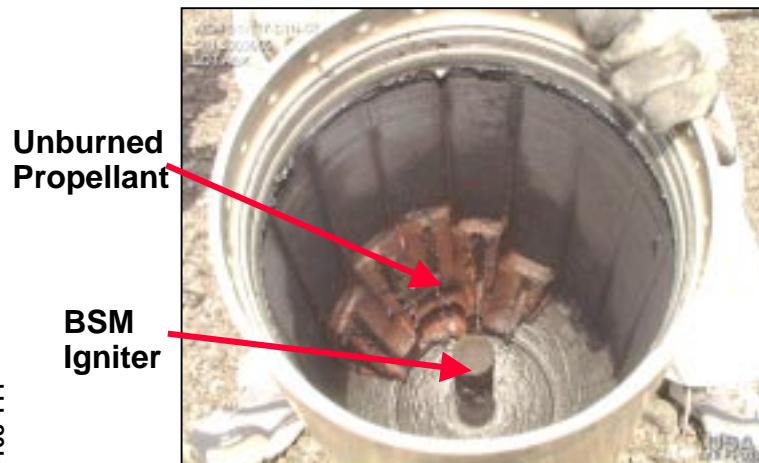
Organization/Date:

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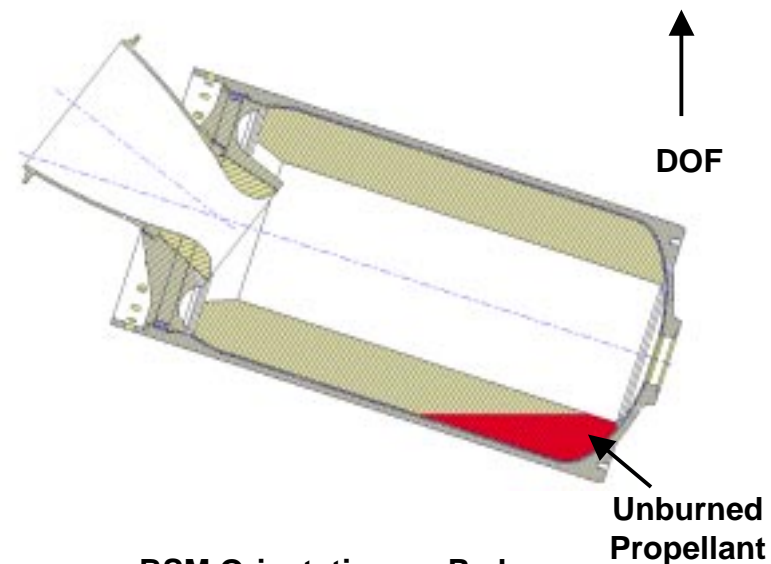
IFA #STS-100-B-01

Observation

- Unburned propellant in RH Forward Booster Separation Motor (BSM) S/N 3003009
 - Centered approximately 180 degrees from top dead center
 - Approximate measurement 100 degrees circumferentially and 1/3 length of BSM case axially



BSM S/N 3003009



BSM Orientation on Pad

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SRB-3

TECHNICAL ISSUE

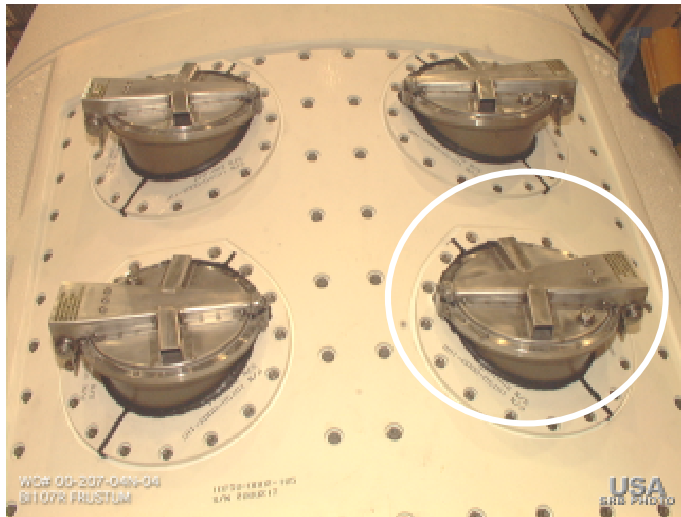
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Presenter:

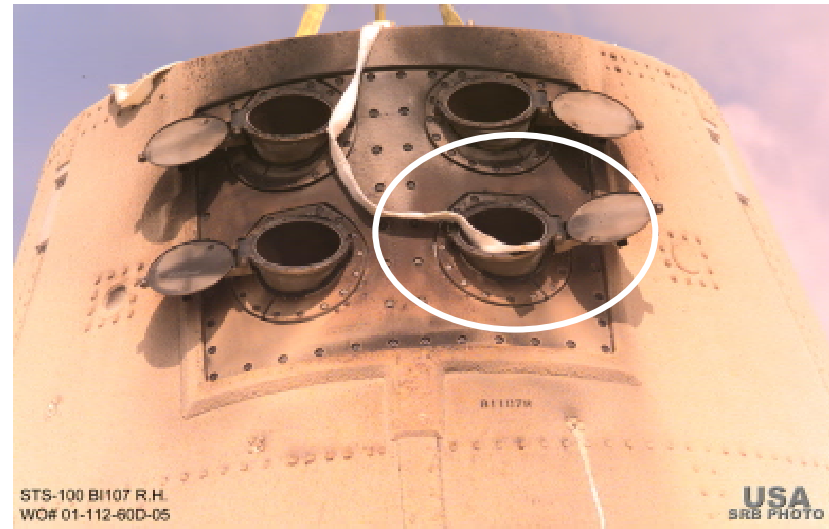
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BSM Cluster Closeout Photo



BSM Cluster Postflight Photo

Concern

- Rupture, burn through or debris ejection
 - Criticality 1
- Failure to ignite, low thrust, premature or delayed ignition
 - Criticality 1R

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Cause

- Moisture contamination at launch pad
 - Water intrusion through Aeroheat Shield (AHS) cover seal

Discussion

- Failure Mechanism for incomplete BSM burn
 - Ammonium Perchlorate (AP) leaches out of propellant
 - Burn rate slowed
 - Ignition not accomplished in heavily soaked areas
 - Final extinguishment when case pressure drops below ~ 7 psia
- AHS Failure Modes
 - Improper cover seal configuration and installation
 - Improper frangible link configuration and installation
 - Post-installation degradation (mechanical, chemical and environmental)

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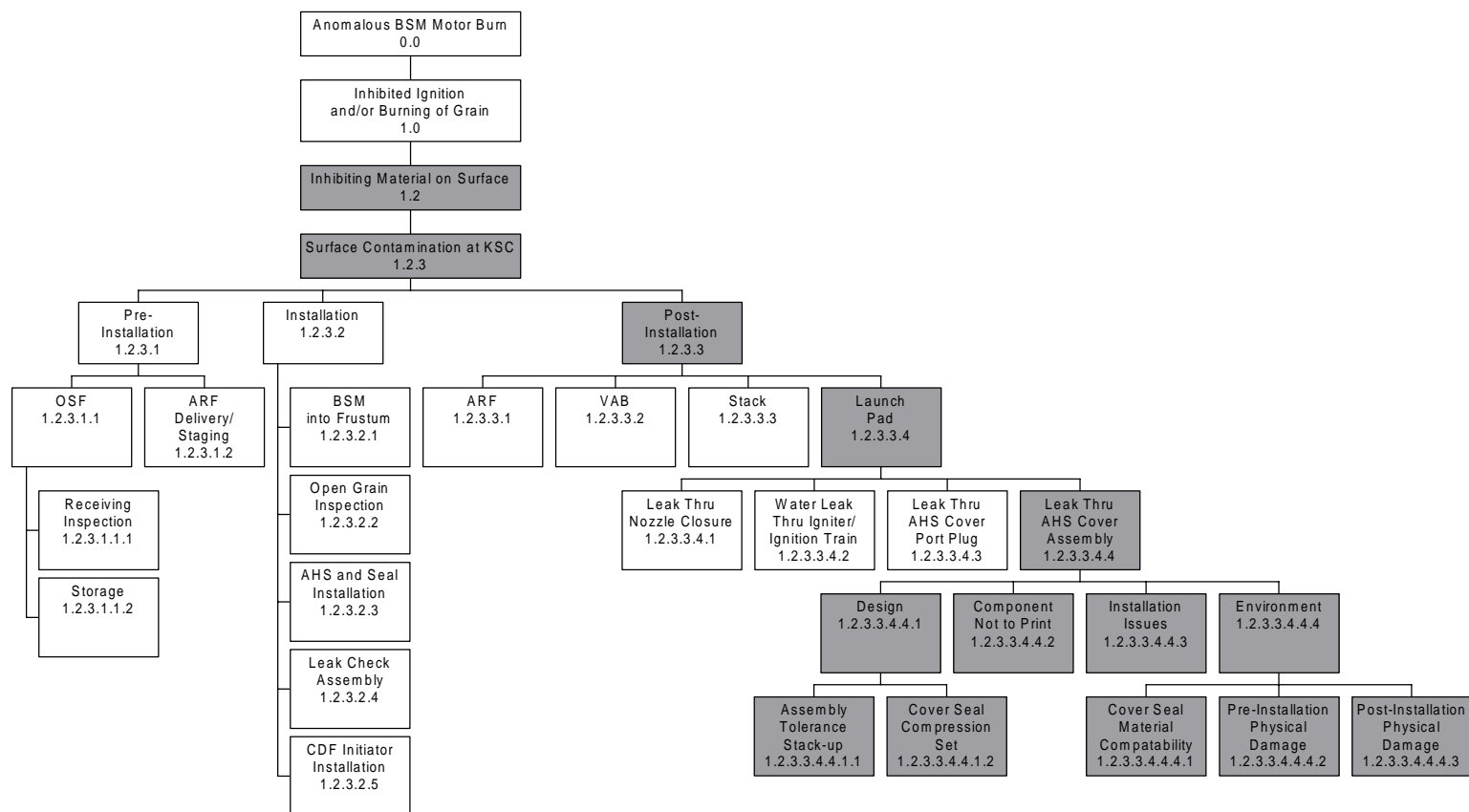
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Discussion (cont.)

- Failure modes identified on Fault tree



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SRB-6

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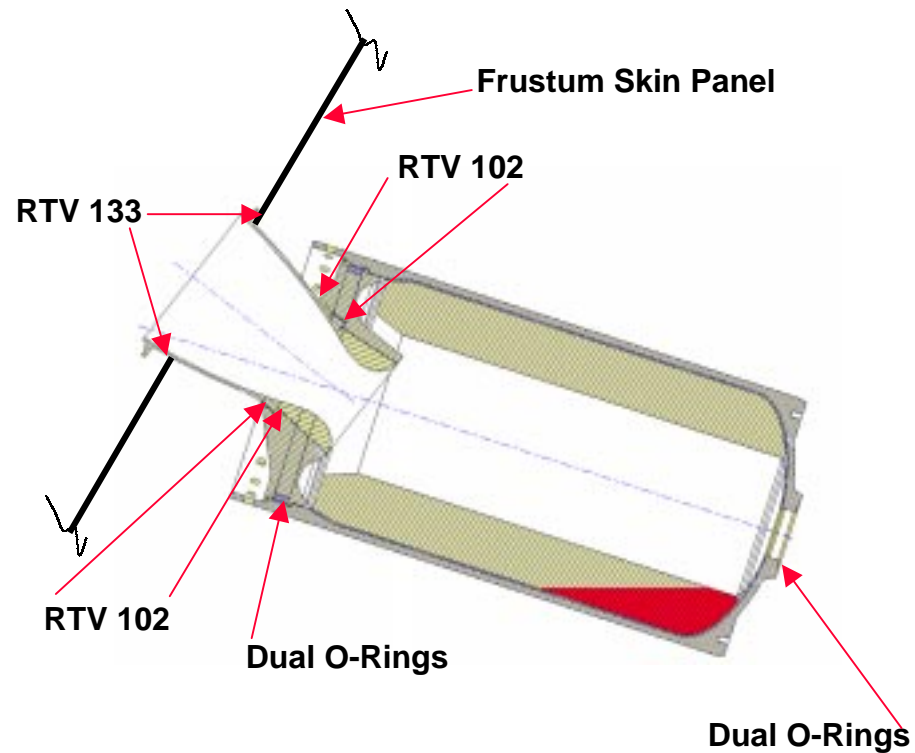
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SRB Forward Assembly

BSM Cluster



BSM Seals
(Aeroheat Shield Removed)

SRB-7

TECHNICAL ISSUE

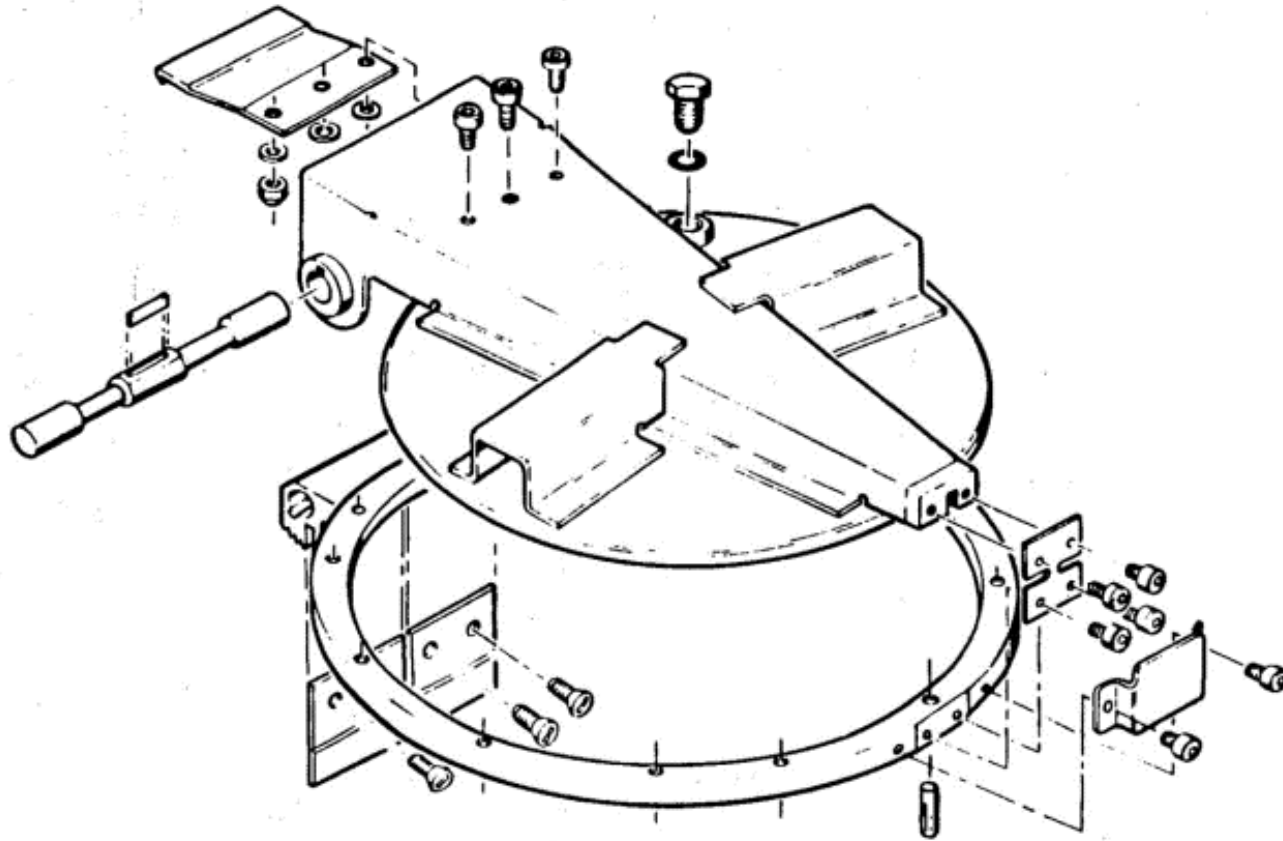
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Booster Separation Motor Aeroheat Shield Assembly - Exploded View

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TECHNICAL ISSUE

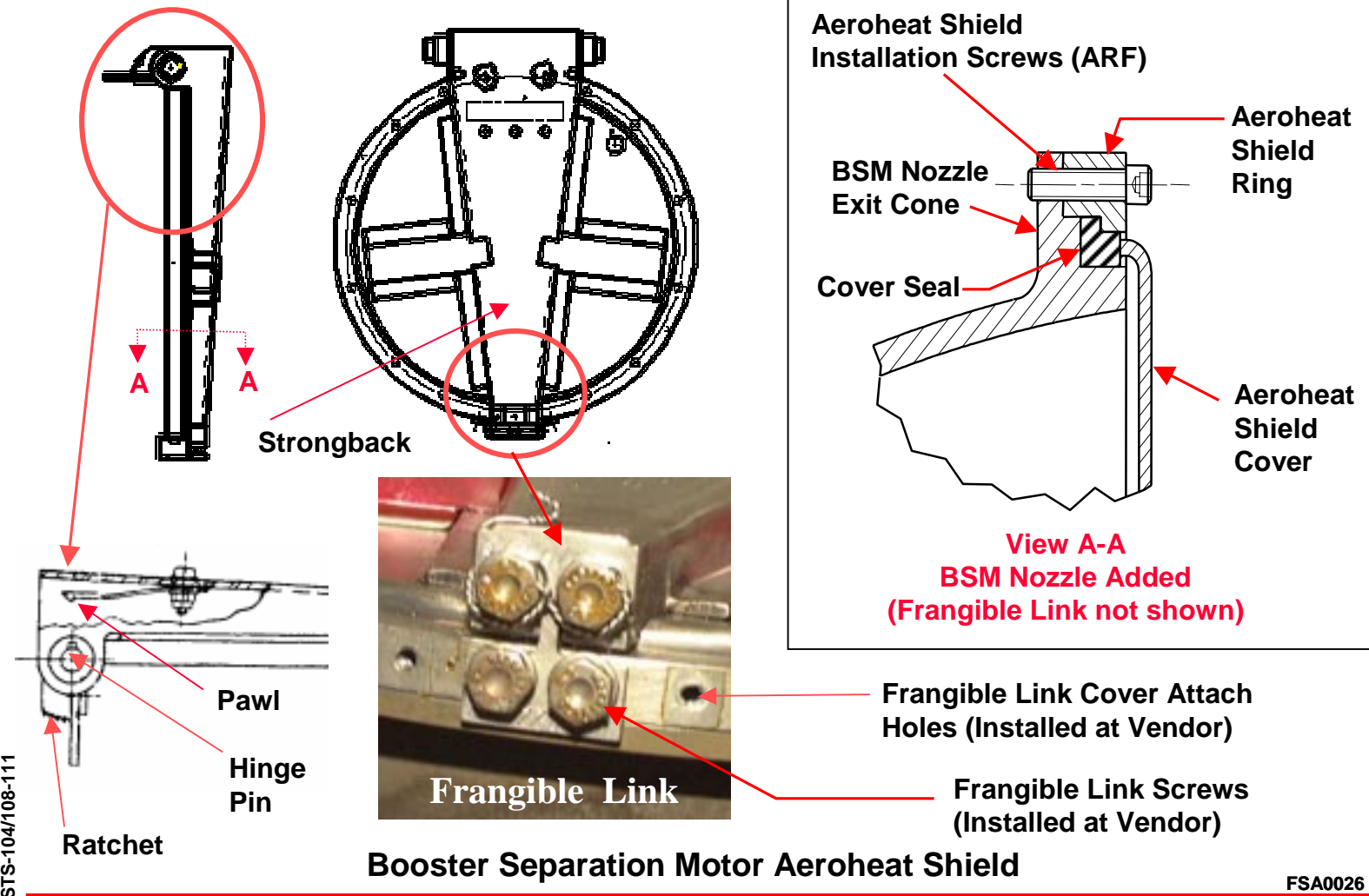
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FSA0026

SRB-9

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Discussion (cont.)

- Cover seal compatibility testing with processing fluids used in BSM area
 - Materials: DC-55 grease, Conoco grease, cleaning solvents, leak detection fluid, buffer solution simulating pH of bird feces
 - No long term gross compatibility issues identified
- BSM Nozzle/AHS rain test
 - Fifty-two tests performed with 1200 in/hr water flow
 - Nominal assemblies tested
 - Incorrect installation and seal damage simulated and tested
 - Damage after assembly simulated and tested
 - Frangible link failure/slippage simulated and tested
 - Oversized and undersized conditions simulated and tested

TECHNICAL ISSUE

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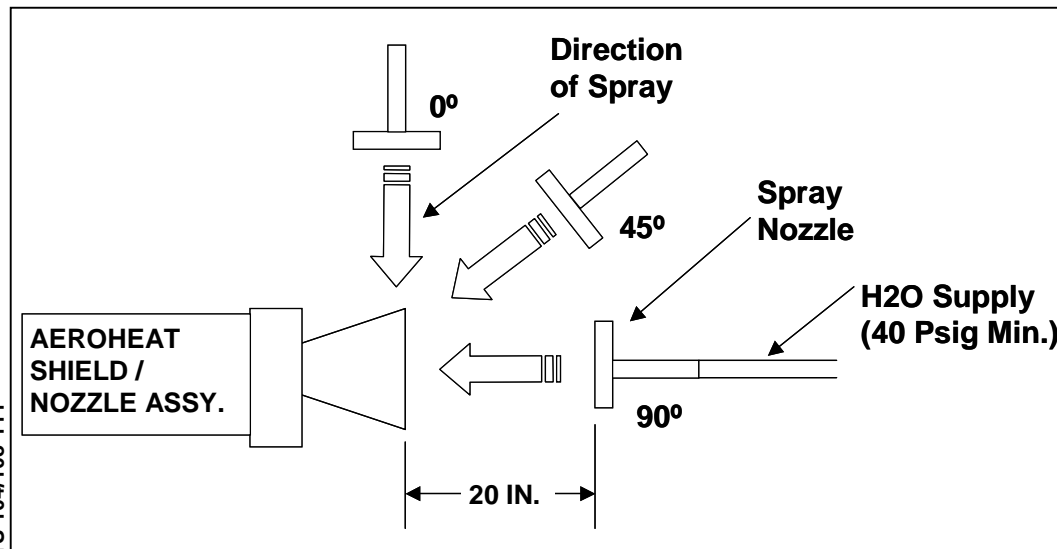
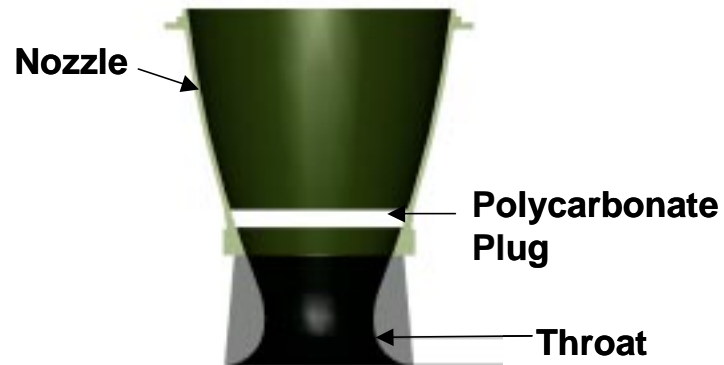
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BSM Nozzle/AHS rain test (cont.)



TEST SETUP

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TECHNICAL ISSUE

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Discussion (cont.)

- BSM Nozzle/AHS rain test (cont.)
 - Test conclusions
 - No water leakage with Minor GN₂ leaks (localized)
 - Very minor leakage into nozzle (if at all) with “kissing seal”
 - Minimal, if any, seal compression)
 - Gross leak or damage required for significant water entry
 - Simulated broken frangible link
 - Three inches removed from upper leg of seal
 - No seal installed
 - Minor leak with loose frangible link bolts
 - Seals that pass GN₂ test will not allow water leakage into nozzle

TECHNICAL ISSUE

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Discussion (cont.)

- Additional AHS testing performed in VAB 06-09-01
 - Testing designed to address all failure modes
- Successfully performed on STS-104

Failure Mode Addressed	Test Title	Test Details	Acceptance Criteria	STS-104 (BI108) Results
Proper Frangible Link Installation	High Pressure	Measure Strongback to Ring Distance; Apply +7.5 to +8.0 psi; Measure Strongback to Ring Distance	Delta distance: +0.010 / -0.005 inch	Delta distance \leq 0.002 inch
Proper Seal Installation and Post-Installation Degradation	Low Vacuum Pressure Decay	Apply -0.5 to -1.0 psi; Perform 5 minute Decay Test	Pressure change \leq 0.1 psid	No Pressure changes
	Mid-Vacuum Pressure Decay	Apply -4.5 to -5.0 psi; Perform 5 minute Decay Test		
	Mid-Positive Pressure Decay	Apply +4.5 to +5.0 psi; Perform 5 minute Decay Test		
	Positive Pressure Bubble Leak Test	Apply +4.5 to +5.0 psi; Perform bubble test	No Leaks	No Leaks
Proper Frangible Link Installation	Final Cover Movement	Measure Strongback to Ring	Delta distance: +0.010 / -0.005 inch	Delta distance \leq 0.003 inch

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Rationale for Flight

- STS-104 BSMs inspected at receiving and prior to AHS installation and verified dry
- AHS seals passed pressure leak test in ARF
- M&P analysis and testing confirm AHS seals remain functional after exposure to known contaminants
- AHS testing demonstrates robust AHS design
- System margins allow for loss of one forward BSM's thrust per SRB at separation
- Integrity of AHS and cover seals reconfirmed
 - Inspected and leak tested in VAB (5-10-01) 10 months after ARF inspection and test
 - Additional extended testing successfully completed 6-09-01 refuting all identified failure modes
- STS-104 is safe to fly

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READINESS ASSESSMENT

Presenter:

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- Pending completion of open work, there are no constraints to launch for STS-104

CERTIFICATION SHEET

Presenter:

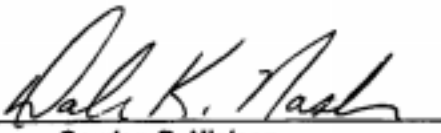
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STS-104 (BI108) Flight Readiness Review

Pending satisfactory completion of open items and normal operations flow, we certify the Booster Assembly hardware ready to support the launch of STS-104

for 
Gordon P. Nielsen
Associate Program Manager/USA
SRB Element


Parker V. Counts
Manager,
SRB Project Office